

The Breeding Biology of Marabou Stork (*Leptoptilos Crumeniferus*) in Zalingei District-Sudan

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ABSTRACT

A study was made on the breeding biology of the Marabou Stork at Zalingei District, West Darfur, State; Sudan. The study was conducted in the time period from December 2006 to December 2007. The objective of this study was to study the breeding biology of the Marabou Stork. Observations on the breeding of the Marabou Stork were made in Zalingei town at Hamidia slaughterhouse, on the east bank of Wadi Areebou, north of Areebou Bridge. The methods used to collect data for this study included wood ladders about 7 m was used to climbing on the nesting tree, and a balance was used for weighing eggs and chicks. Different aspects of breeding habits, nest building, egg laying, incubation, hatching and linear body measurements of Marabou Stork chicks were carried out. The Marabou Stork population in this area was recorded daily. The Records indicated that the number of individuals that were counted daily in Zalingei District was between 60 and 90. Only eight pairs repaired old nests, mated and laid eggs. The incubation period, and growth and development of the chicks was followed and recorded in five nests. The other three nests were difficult to reach and study. The results are discussed and Recommendations are made for future research on the conservation of the bird fauna in the study area.

Keywords: *Breeding, Marabou Storks, Zalingei district- Sudan.*

1. INTRODUCTION

The Marabou Storks ranged in distribution all over Sub Saharan Africa from Senegal east to Somalia, [3,16], and were rare in South Africa, [12, 8,7]. Marabou Storks in Sudan were commonly found in many habitats, often near human settlements. They migrate north during the rains but they breed mostly in Southern Sudan [14, 4. Marabou Storks were more or less gregarious birds. Sometimes single individuals were found in both aquatic and terrestrial habitats. They usually prefer open or semi arid areas but they can be found in forested areas and true deserts [2]. The favorable habitats to Marabou Storks are those near water where most Storks live as waders in shallow pools and marches in search of food in the form of fish, frogs. Near human habitations they feed on carrion and scavenge on waste collection sites or rubbish dumps [15, 2].

1.1 Study Area

Zalingei is located in Western Darfur State-Sudan in the western part of the Jebel Marra. Geographically it falls in the poor savanna zone It covers about fifty square kilometers in the poor savanna zone between latitudes 12° 30 and 13° 30 North, and longitudes 22° 20 and 23° 45 East[11]. Zalingei area is traversed by many seasonal streams known locally as Wadis and khors. These seasonal streams come down from Jebel Marra and flow westwards. Wadi Azumm and Wadi Areebou are the most important seasonal streams. In the dry season these two Wadis stop running and many permanent water pools are left in their beds. These pools are used by various species of birds for drinking and feeding [10].

1.2 Objectives

The objectives of this study were:

To study the biology and breeding of Marabou Stork *Leptoptilos crumeniferus* in Zalingei town. This was why this bird was selected for study.

2. MATERIAL & METHODS

2.1 Data Collection

The data was collected from the first of May 2006 until the end of December 2007. The observations on the breeding of the Marabou Stork were made in Zalingei town at Hamidia slaughterhouse, on the east bank of Wadi Areebou, north of Areebou Bridge. The Marabou Stork population in this area was recorded daily. Different aspects of breeding habits, nest building, egg laying, incubation, hatching and linear body measurements of Marabou Stork chicks were carried out. The methods used to collect data for this study included wood ladders about 7 m used for climbing the nesting trees, and Balance for weighting eggs and chicks, the Individual chicks were identified by marking with marker pen, the linear of body measurements of each chick were taken using a measuring tape. The weight in grams of each chick was recorded every fifteen days until the chicks were forty five days old. Further records were not possible because they were too big and too aggressive to handle.

2.2 Data Analysis.

SPSS software was used to analyze the data collected; the frequencies and percentage of the each variable were calculated.

3. RESULTS

3.1 The Marabou Stork (*Leptoptilos Crumeniferus*)

3.1.1 Field Observations.

Field counts indicated that ninety to sixty Marabou Storks was seen at Zalingei every day. The Marabou Stork is a very large heavy-bodied bird with a bare head and a bare neck having a throat pouch and a long heavy bill, and bare long black legs, and having red mottled feathers in the base of neck, see Plate 1. It has a throat sac in throat, see Plate 2. Marabou Storks like Vultures in flying but it had larger dangling legs, and flying with retracted neck like herons, see (Plate 3). Marabou Storks were found in the slaughter house waiting for workers to throw them scrap meat, were tame birds and were not disturbed by human activity. The same can be said about individuals found on the banks of Wadis and water pools hunting for food (Plates 4.5 and 6) During the daytime the Marabou Storks usually stay, sometimes for several hours in one place, sometimes standing on one leg or squatting on their tarsal joints. In windy days they descend from trees and stay on the ground until the storm ends. Sometimes Marabou Storks gather in large groups to sunbathe or rest and perch high in tress or open land near the nest tree.



Plate 1: Red Circle at the dorsal Base of Neck appears during breeding season



Plate 2: Marabou Stork showing Throat Sac



Plate 3: Marabou Stork in Flight.



Plate 4: A Marabou Stork feeding on pieces of meat thrown away by workers at Hamidia Slaughter House.

<http://www.ejournalofscience.org>**Plate 5:** Marabou Storks in Wadi Areebou.**Plate 6:** A Marabou Stork in a pool near Hamidia.

3.1.2 Breeding

Only eight pairs of a population of between 90 and 60 Marabou Storks at Zalingei District nested and reproduced near Hamidia Slaughterhouse on the northern bank of Wadi Areebou. All eight pairs nested on a single Haraz tree, *Fadherbia albida*. The tree had old nests. There were a number of other large trees near to the nesting tree that include Haraz, and Haglig (*Balanites aegyptiaca*). Nesting on the same tree possibly gave protection against predators. There were open spaces near to nesting tree where some nesting materials could be gathered. The nesting tree was close to Hamidia slaughterhouse which provided an important source of food for both adults and nestlings. The first pair of Marabou Storks came to nesting tree on 21/6/2007 and chose one of the old nests and started to make courtship displays such as clattering their bills, and inflating their throat sacs to make whistling or mooing calls. This was accompanied by bending the neck till the head touched the back; the wings were usually fully spread, and the feathers of the body fluffed. The first pair of Marabou Storks started repairing their nest on the 1st of July 2007. A few days later the seven other pairs started repairing the old nests. The first mating was observed in 8/7/2007. All courtship and mating activities were made on the nests. It was apparent that a male was not allowed to approach the female if the nest was not fully repaired (Plate 7).

**Plate 7:** Mating Marabou Storks.

3.1.3 Nests.

Marabou Storks nests are large open platforms of dry sticks, branches and twigs lined with leaves and grasses. Nest repairing started on first week of July 2007 and apparently each pair of Marabou Stork reused its old nest. Out of ninety birds in the area, only eight pairs bred in the 2007 season. [They built 8 nests on a big tree of *Fadherbia albida* 12 meters high with a canopy 10 meters in diameter.] Five nests were chosen for study because of their accessibility. The mean height of these nests above the ground was $11.35 \pm$ meters. The average diameter of a nest was $95.8 \pm$ centimeters, and the mean nest depth was $31.4 \pm$ centimeters (Table 1).

3.1.3.1 Nest Construction Materials.

Nest materials were gathered from the area surrounding the nest site. The length of dried twigs and branches used for nest building varied between 15 and 100 centimeters. During the incubation period no building materials were added to the nest.

Table 1: Nest height from the above ground and nest dimensions.

Nest No	Height from ground Surface in meters	Diameter of Nest In centimeters	Depth of Nest In centimeters
1	10.27	122	51
2	12.78	100	22
3	12.05	82	27
4	11.90	69	18
5	9.77	106	39
Mean	$11.354 \pm$	$95.8 \pm$	$31.4 \pm$

3.1.3.1 Eggs

The first egg was laid on 7/8/2007 in nest number one, and last egg laid in 4/9/2007 in nest number five. Females laid 2 to 3 white eggs (Plate 8). The mean egg weight was $152.05 \pm$ grams, range (150.02 - 153.21) grams. Mean eggs length $10.25 \pm$ centimeters, in a range

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of 9 to 11 centimeters. The mean egg's width was $8.66 \pm$ centimeters, in a range of 7.5 - 9.5 centimeters, (Table 2).



Plate 8: Marabou Stork eggs in the nest soiled with faeces

Table 2: Date of egg Laying, egg number and egg dimensions

Nests	Date of Egg laying	Egg Number	Egg Weight(gm)	Egg Length(cm)	Egg Width (cm)	Sequence of egg laying
Nest-1	7/8/2007	Egg-1	153,21	11	9.5	7
	9/8/2007	Egg-2	153,21	11	9.5	
	13/8/2007	Egg-3	153,21	11	9.5	
Nest-2	13/8/2007	Egg-1	150,02	9	7.5	4
	14/8/2007	Egg-2	150,02	9	7.5	
	16/8/2007	Egg-3	150,02	9	7.5	
Nest-3	25/8/2007	Egg-1	152	11	9.5	3
	27/8/2007	Egg-2	152	11	9.5	
Nest-4	27/8/2007	Egg-1	152,21	11	9.5	3
	29/8/2007	Egg-2	152,21	11	9.5	
Nest-5	3/9/2007	Egg-1	152	9.5	7.5	2
	4/9/2007	Egg-2	152	9.5	7.5	
Mean	-	$2.5 \pm$	$152.05 \pm$	$10.300 \pm$	$8.700 \pm$	

The mean clutch size was $2.5 \pm$

3.1.4 Incubation:

Both parents shared in guarding and incubating the eggs. The incubation period lasted for $28.92 \pm$ days for five nests (Plate 9 and Table 3).



Plate 9: Marabou Storks during the incubation period

Table 3: Incubation Period and Date of Hatching, Date of First Flight and Length of Hatchling's Life.

Egg	Incubation Period(days)	Date of Hatching	Date of Flight	Length Of Hatchling Life (days)	Sequence of Hatching
Nest-1	31	7/9/2007	11/11/2007	65	4
	31	9/9/2007	11/11/2007	67	
	28	10/9/2007	14/11/2007	72	
Nest-2	29	11/9/2007	18/11/2007	68	4
	28	11/9/2007	18/11/2007	68	
	28	13/9/2007	18/11/2007	70	

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Nest-3	31	25/9/2007	26/11/2007	60	2
	30	26/9/2007	28/11/2007	61	
Nest-4	26	22/9/2007	6/12/2007	75	1
	28	22/9/2007	7/12/2007	78	
Nest-5	27	30/10/2007	15/12/2007	76	6
	30	4/11/2007	15/12/2007	80	
Mean	28.92 ±	-	-	70 ±	
Range	26-31	7/9/2007- 4/11/2007	11/11/2007- 15/12/2007	60-80	

3.1.5 Hatching.

Hatching was not synchronized, although in nest 4 hatching was synchronized and in nest 3 hatching was within 2 days. Hatching started on 7/9/2007 and continued until 4/11/2007. Nesting Success was very high, all eggs hatched. Immediately after hatching the chicks weighed an average of 0.173 ± kilograms. However, they grew quickly to reach a weight that averaged 1.982 kilograms in 15 days. The growth continued until they reached an average weight of 3.356 kilograms in 30 days. The growth rate of 30-45 day-old chicks was slightly slower compared to younger chicks (Fig. 1).

3.1.5.1 Newly-Hatched Chicks

The Plate 10 showed the newly-hatched chicks, the body is bare except for a few downy feathers. Generally the body is white with a few black spots. The beak was red with scattered black spots. The eyes were open and are black in color. The legs are long, bare of feathers and red in color. The neck and tail were bare of feathers while the head was covered with little downy feathers. Mean weight of new hatchlings in the first day was 0.173 ± kilograms in range of 0.170 - 0.175 kilogram with mean increase 1.727 ± kilograms (Tables 4). The morphometric measurements of newly hatched chicks were recorded and the mean length of body parts is shown in (Tables 5).



Plate 10: Newly-hatched Marabou Storks Chicks

3.1.5.2 Fifteen days-old Chicks.

In fifteen days-old chicks were generally no changes in colors see Plate 11. The mean chicks weight was 1.9 ± Kilograms in range of 1.791-2.000 kilograms with mean increase 1.727 ± kilograms (Tables 4). The two wing span changed from 18.283 ± centimeters to 42.083 ± centimeters, wing length was 21.041 ± centimeters and the beak length was 10.666 ± centimeters from base of skull to tip, and the tail length was 3.166 ± centimeters Tables 7 and Table 13.



Plate 11: Fifteen days-old Marabou Stork chicks

3.1.5.3 Thirty days-old Chicks

Thirty days-old chicks were covered with white downy feathers and lost most of the dark spots found in fifteen days-old chicks (Plate 12). The mean chick weight was 3.459 ± kilograms range of 3.386 - 3.501 kilograms with mean increase 1.559 ± kilograms (Table 4). The morphometric measurements of chicks are shown in (Tables).

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Plate 12: Thirty days-old Marabou Stork chicks

3.1.5.4 Forty-Five Days-Old Chicks

The chicks were generally covered with white downy feathers but black feathers started to grow on the wings and back. The beak color changed from red to pink (Plates 13). The mean chick weight was $4.0301 \pm$ kilograms, in a range of 3.800 - 4.220 kilograms with mean increase constancy $0.5711 \pm$ kilograms (Table 4). The mean body length was $44.75 \pm$ centimeters from neck to tail, with wing span $126.166 \pm$ centimeters, and wing length $62.916 \pm$ centimeters, the beak from base of skull to the tip $17.8 \pm$ centimeters, and the tail length was changed to $7 \pm$ centimeters (Tables 5).



Plate 13: Forty-five days-old Marabou Stork chicks

3.1.5.5 Chicks Forty-Five Days-Old to Fully Fledged Adults

The upper body color gradually changed to black with a green gloss on the upper parts with white under parts and a pink beak. The wings were fully feathered and the chicks started flapping their wings to strengthen them for flight. Chicks at the age of more than 45 days, nearly reached adult size and became very aggressive and they used their beaks to inflict deep wounds when handled. Thus the body weight and measurements could not be taken. When fully developed fledglings flew together with their parents to hunting and feeding grounds (Plate 14). The relationship between body weight and age are shown in (Table 4)



Plate 14: Fledglings with their Parents in Hamedia Slaughterhouse

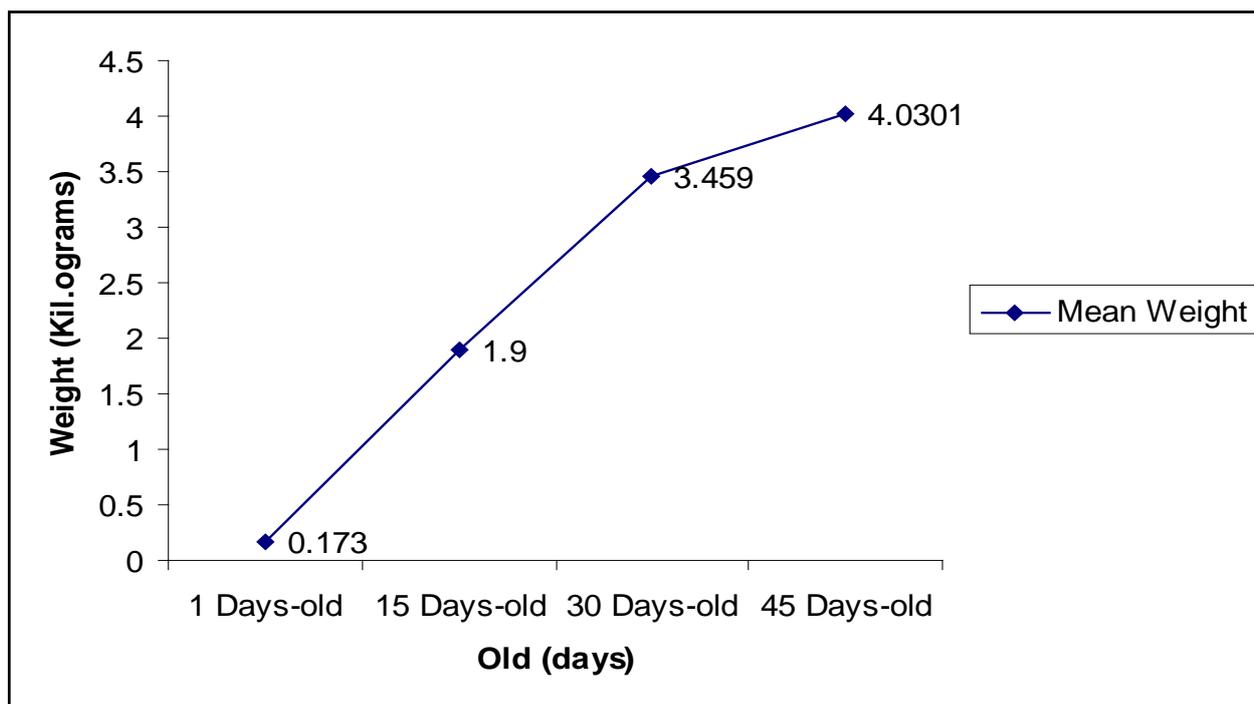


Fig 1: Growth rate of Marabou Stork chick

Table 4: Mean and individuals Weight of chicks in kilograms (days old)

Chicks No	Weight in kilograms			
	1 st days old	15 days old	30 days old	45 days old
1	0.175	2.000	3.501	4.220
2	0.174	1.946	3.501	4.220
3	0.175	1.890	3.501	3.900
4	0.170	1.801	3.386	4.120
5	0.173	1.800	3.387	4.120
6	0.173	1.791	3.396	4.110
7	0.175	1.989	3.500	3.810
8	0.175	1.991	3.5 01	3.821
9	0.173	1.990	3.503	4.220
10	0.173	2.000	3.431	4.220
11	0.170	1.801	3.456	3.800
12	0.170	1.801	3.456	3.800
Mean Weight	0.173 ±	1.9 ±	3.459 ±	4.0301 ±
Range	0.170-0.175	1.791 -2.000	3.387-3.503	3.800-4.220

Table 5: Mean Morphometric measurements of chicks in centimeters

Chicks body parts	Mean Length in centimeters			
	1 st days old	15 days old	30 days old	45 days old
Wing Length	9.141 \pm	21.041 \pm	44.083 \pm	62.916 \pm
Wingspan	18.283 \pm	42.083 \pm	88.166 \pm	126.166 \pm
Leg Length	7.208 \pm	23.266 \pm	40.716 \pm	54.508 \pm
Neck Length	9.583 \pm	16.583 \pm	22.583 \pm	29.258 \pm
Beak Length	4.041 \pm	10.666 \pm	14.775 \pm	17.8 \pm
Tail Length	1 \pm	3.166 \pm	5.0 \pm	7.0 \pm
Body Length	7.416 \pm	13.421 \pm	34.183 \pm	44.75 \pm
Height	19.125 \pm	41.383 \pm	71.333 \pm	110.866 \pm
Throat Sac Length	9.85 \pm	12.0 \pm	14.633 \pm	18.258 \pm

4. DISCUSSION

Birds are adapted to withstand various environmental conditions from the hot tropical regions to Palearctic zones. These wide limits of tolerance and adaptability allowed them to occupy a large number of habitats [10]. Zalingei District is characterized by seasonal streams and water pools during the rainy season as well as two large permanent water pools: Hamedia and Adam Golla. These wetland habitats are attractive to various species of birds for feeding and drinking. The species of birds included both resident and Palearctic migrants. The resident species usually breed in the rainy season while the migrant species breed in their palaeartic countries and spend the winter season in warm African countries rich in various kinds of food. This study was conducted in the year 2007 during civil troubles and war time in Darfur. The war possibly affected and disturbed the birds in the study area. The Zalingei District was not fully safe and for this reason the study covered only seven relatively safe areas within the District. According to [14,1] Marabou Storks were common in many habitats in Sudan and they breed in Southern Sudan and migrate to the northern Sudan in the rainy season. In this study Marabou Storks were resident in Zalingei District in all seasons. According to the local people Marabou Storks were unknown in the area before 2003. This was the year in which fighting started in Darfur and it is not known whether the disturbances had any role in their coming to Zalingei District. Marabou Storks are important to the environment because they feed on dead animal's carcasses [5, 6, 13]. Marabou Stork *Leptoptilos crumeniferus* breed during the rainy season in Sudan, other Storks nesting does not started until several weeks after the commencement of the rains. This delay is almost certainly adaptive because it ensures that insects (grasshoppers, locusts) which from the diet in young are abundant at the

time of hatching [5,8] believes that the sight of rainfall is "Zeitgeber" which initiates breeding, and the correlation between peaks of rainfall in *Leptoptilos crumeniferus*, and the nesting activity approximately. Weeks later Suggest that this may be so in this species. Marabou may be suggest that conditions grass cover is limited factor litigating breeding in *Euplectes orix* Body condition of the individual may be move on set of breeding (see page 3). According to Burton et al 1974, and Brown, et al 1982, Marabou Storks breed in high trees and cliffs which may be 30 to 40 meters high. In this study Marabou Storks bred on a single *Fadherbia albida* tree 12 meters high. The Marabou Storks bred in high places to protect their nestlings form predators. The breeding season varied in different regions of Africa. In Zimbabwe it took place between June and September, in Botswana July to August, in Zambia and Tanzania in June and July, in Ethiopia and Somalia October to November and in West Africa December to February [8]. In Sudan the Marabou Stork breed in November and December [1,14,4]. Only eight pairs of Marabou Storks out of a total number that varied between 60 and 90 mated and laid eggs. All nests were on a large single tree. Other individuals of Marabou Storks did not breed although there was no shortage of food, water and nesting trees. All individual Marabou Storks showed the red circle on the dorsal base of the neck which usually appeared only in breeding season. However the circle was bigger and more prominent in breeding pairs. This needs further investigation to find out whether the breeding pairs of Marabou Storks were different physiologically from the non-breeding individuals. During the breeding season Marabou Storks faced no problems with predators or disease and no loss in eggs or nestlings. During this study both male and female Marabou Storks shared nest building and collected the building materials. There were no problems of food

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shortage and drinking water during nest building, because Wadi Areebou and Wadi Azoom and all Khors were running. The Marabou Storks copulation lasted for a few seconds and was performed inside the nest during the time of nest building. In many species of birds males and females meet only for the act of copulation and remain separate for the rest of the year. Marabou Storks were monogamous birds and the bond between a pair was not broken before their nestlings were fully grown [9,2]. The female laid two to three eggs [8]. But [17.9] reported that the female laid 2 to 5 eggs which were laid at two day intervals at the end of the rainy season. Females laid two to three eggs at two days intervals. Incubation of the eggs was shared by both parents and the eggs on average hatched in $28.9 \pm$. This agrees with [6]. The chicks grew quickly and at the age of two months the chicks started to fly accompanied by their parents who possibly taught them how to hunt and collect food [17, 9].

5. RECOMMENDATIONS

The following recommendations are suggested:

1. Further surveys of birds should be made in Zalingei District to cover all seasons of the year.
2. Establishment of protected areas for birds with emphasis on the participation of local people.
3. Training wildlife staff and local people on bird's conservation activities and supplying them with the needed tools to enable them to perform their work safely and easily.
4. Additional studies should be carried out on the breeding of Marabou Stork in the Sudan.

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